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Abstract

This paper describes a software which is inspired by notions originating from the management context on learning organization and knowledge management and which is characterized for making integrated use of the information systems and knowledge engineering to support these notions. This software considers the individual as the source of the whole organization's wealth. The basic premise is to set up conditions that favor the full development of all people directed to the full development of the organization. The software has a participative arena where people in the organization can express their abilities, intentions and opinions. It uses Artificial Intelligence techniques of knowledge acquisition and representation to allow efficient manipulation of the organizational memory created by people when they interact in the participative arena.

Introduction

Knowledge is a fundamental asset within the business context, imposing itself as a decisive variable in the Organizations' life. Aspects related to the mechanisms of creation, representation, diffusion, marketing and exploration of knowledge should be analyzed and understood so that we can get a differential advantage in a competitive environment. The management of all those aforementioned mechanisms is defined as knowledge management.

Another concept adjacent to the increasing relevance of the role of knowledge in organizations is the learning organization. Here we highlight the continuous learning aspect (knowledge acquisition) to which people in an organization are submitted and as a consequence, the development which the organization begins to experience due to this learning process.

In order to successfully carry out knowledge management, as well as to follow up, to induce and even to carry out the organizational learning process, it is necessary to have computer support which provides agility and reliability to the process. Fundamentally, the information systems (IS) constitute this support by allowing individuals to deal with great volumes of information and, the dynamics frequently linked to information besides being an essential object to the building of organizational memory.

The IS, however, do not constitute the only alternative to help knowledge management. The artificial intelligence (AI) through, for example, the Knowledge-based systems, intelligent agents, the processing of written natural language and machine learning systems are increasingly being used to assist knowledge management. These AI areas have in common the fact of having knowledge as the main object of manipulation, thus characterizing the Knowledge Engineering.

This paper describes a software, called MC^2, which is inspired by notions originated from the Management Systems about learning organization and knowledge management and which is characterized for making integrated use of the Information Systems and Knowledge Engineering to support these notions. MC^2 considers the individual as the source of the whole organization's wealth. *MC^2 strategy* aims at setting up conditions that favor the full development of all people directed to the full development of the organization. MC^2 defines computerized procedures that provide efficiency to the relationship among people in an organization.

This article is made up of five sections. First, we will make basic definitions of concepts within both the learning organization and the MC^2 context. In Section 3, we describe the general idea of MC^2. In Section 4, we specify the main MC^2 expression modules. In Section 5, we describe the agents that compose the knowledge level in MC^2 and we will end with trends for future works.

Background Knowledge

Learning Organization (LO) is a very discussed concept nowadays since it is agreed that the rate at which an organization learns may become its only sustainable source of competitive advantage. We consider Malhotra´s definition that a "learning organization is to have an ingrained philosophy for anticipating, reacting and responding to change, complexity and uncertainty" (Malhotra 1996). We would like to emphasize that achieving a learning organization, however, is possible through individual learning, so it is necessary to create an environment that motivates the latter.

The MC^2 ideas were born from experiences in the managerial context where we realized that learning requires people's participation and collaboration. We consider that participation leads people within an organization to be more active, contributing to enterprise development. MC^2 key idea is to promote the development of people and to assure that this can be translated into permanent organizational learning.

The MC^2 ideas were equally inspired by learning organization theory on system administration (Senge 1990) and constructive and social learning theories (Vygotsky 1978, Wertsch 1985) that claim the importance of the social context during the learning process.

To induce people's participation, it is necessary to implement, within the organization, efficient and structured ways where the attributions, roles and responsibilities can be done in practice. The use of IS as a tool for helping in the process of people's participation is fundamental (Huber 1990; Davenport 1997). IS are important in LO for serving organizational memory and for distributing information. Furthermore, AI techniques have been recently studied to help knowledge management and the amount of works about this subject is rapidly growing (Gaines at al. 1997; Gamble 1998).

Following this trend, we have developed MC^2 that aims at giving efficacy to people's relationship standards, based on participation. MC^2 acts as the tool to formalize, support and control the actions originated from people's participation and, consequently, organizational development.

MC^2 Overview

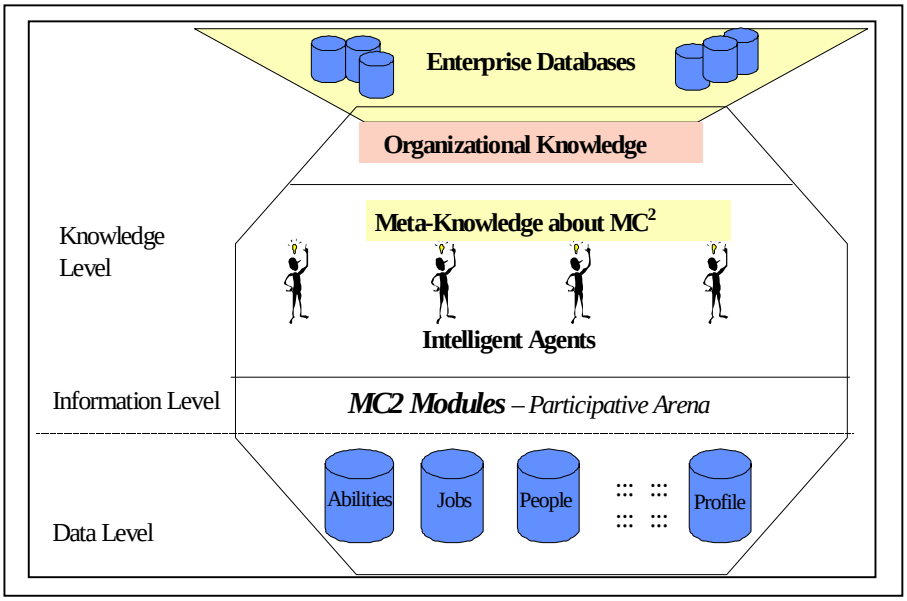
In general lines, the objectives of MC^2 are to assist the knowledge management and to induce the organizational learning through the use of automated tools based on AI and IS. The general MC^2 architecture is modeled on intelligent agents that capture information handled by individuals in their work context and transforms this information into knowledge for decision-making. Figure 1 shows the MC^2 architecture with its three levels: the *data level* where the data about the organization and individuals are recorded; the *information level*, which we also call *participative arena*, where the computerized procedures which provide efficiency to the relationship among the persons in the organization are represented; the *knowledge level* which is formed by software agents that aim to support the creation, research and utilization of knowledge which permeates the organization.

The participative arena has tools to (i) formalize knowledge about organizational strategies, (ii) permit different ways of recording and accessing information about people's abilities and problem solving, (iii) allow the individuals of the organization to exchange ideas and experiences about past situations.

The tools that make up the knowledge level assist the knowledge management and give power to the organizational learning. These tools support the activities that are carried out by people in the organization when they are doing their professional tasksin order to capture and represent knowledge. Basically, two types of knowledge are modeled: (i) knowledge about MC^2 (meta-knowledge) which is used by agents to automate internal activities to the operation of the system and (ii) knowledge concerning the organization itself.

Agents that own meta-knowledge serve to find a person with the ability to do a certain activity, to analyze candidacy to *multiplier* (supervisors responsible to coordinate MC^2 implementation), to check integrity of information received by the system, etc. Agents that manage the organization's knowledge try to formalize knowledge about problem solving, to find out new knowledge hidden in the database of the organization, to sharing knowledge with different organization sectors, etc. The formalization of the organizational knowledge opens innumerable possibilities of increasing the organizational learning in MC^2.

Figure 1. MC^2 architecture with its three levels



The most relevant one is the fact that the intelligent agents act as inducers of discussions and diffusers of knowledge about subjects related to the end activities of the organization. Let us take as an example an enterprise that supplies Internet services. An answer given by the help-desk employee to a client about a problem that the latter faced can generate a discussion within the organization serving for diffusion, sharing, standardizing or even criticism of the posture taken on at that moment.

In this way, many of the mechanisms made available by the MC^2´s information level are activated to deal with the subject, from an opinion poll to a cataloguing of the experience passing by a proposal of multiplication done by the system to the Facilitating the Participation in MC^2 person who carried out the activity.

Since MC^2 considers participation important to the organization's development, MC^2 structure has several modules to ease individual expression. These modules, which compose the participative arena, are divided in 5 categories and we describe them as follows.

Central Structure

The organizational strategy is represented in the central structure by its relation to the domain of essential competencies. Its mission consists of carrying out – step by step – in a methodical and systematic way – the organizational learning starting from individual learning vectors: definition, commitment, learning, register, location, diffusion, creation, application and updating.

	**LECs –** List of essential competencies of the organization
	**Proposal and Development Record –** Place for the individuals to be able to affirm their commitment with the continuous learning
	**Multipliers**– Module where it is possible to deal with the *multipliers* who will be responsible for investing energy and emotion to implement MC^2 strategy

Expression Modules

MC^2 possesses 12 modules to represent different modalities of human talent expression. Through them, the individual intelligence – ideas, values, abilities, proposals, experiences, and intuitions – flows itself as a valuable and continuous contribution to the common development. Figure 2 shows how the MC^2 tools are organized in the screen.

	**Patrimony –** Electronic library to store knowledge generated in the organization
	**Articles –** Repository where ideas and experiences lived support the search of solutions for new problems
	**Autotest–** Database of competencies and abilities which promotes the continuous professional updating
	**Consultations –** Database of questions and answers resulting from accumulated knowledge by specialists in each area
	**Eureka! –** Follows the steps of an idea, from the first insight to its implementation
	**Forum –** List of discussion where the central subjects for the organization life find are discussed
	**Groups –** Productivity tools for teamwork.
	**I.E.M. –** Indoor Environment Monitoring – the essential points of the organization life are followed step by step
	**News –** Tool for Information transmission from all to all
	**Voting – W**here votes are carried out transforming "impressions" into information, to support decision making
	**Profile –** Where the several organization policies start being adapted by those engaged in implementing them
	**Professional Activities –** Space where special contributions of personnel concerning their professional activities is recorded
	**5S Action! –** Space which allow participation to improve the 5S Program

Communication Modules

MC^2 suggests the implementation of a relationship model, based on collaboration and interdependence. Here, individuals of the organization can exchange ideas and experiences about situations lived. Besides, this module serves as a communication instrument between staff and employees. This provides a high level of intercommunication among people, overcoming physical obstacles, distances and strict schemes of hierarchy. The communication instruments in MC^2 are:

	**Notes –** Intelligent e-mail. It increases the efficiency of individual and groups' actions
	**Panel –** Electronic bulletin board open to the formal and the informal communications
	**Hot Line –** A chat with special resources to increase productivity in the operational actions
	**Offers –** So that the opportunities of new knowledge come to all. So that all may offer their new knowledge to others
	**Telefact –** A record of everyday conquests prepared by their protagonists.
	**Workshop –** Where MC^2 System receives suggestions about itself and can grow with the suggestions of its users

Query Modules

Query modules permit the members of the organization to find answers to frequent questions about

personnel, problems and solutions, abilities, rules and basic concepts of the organization.

Through the "all see all" module the individual development actions, as well as omissions, can become transparent:

	People – To know – and to integrate – the people who make up the organization
	Entities – Each concept brings a tool to expand people's capacity to act on the organization
	Development Research – Mirror of contributions of each person to the common development
	Systemic Query – Lists totality of the effort performed by the organization in regard to the interest of who does the research
	Database of Talents – To find the right person based on his/her building up, professional experiences and abilities

Support Modules

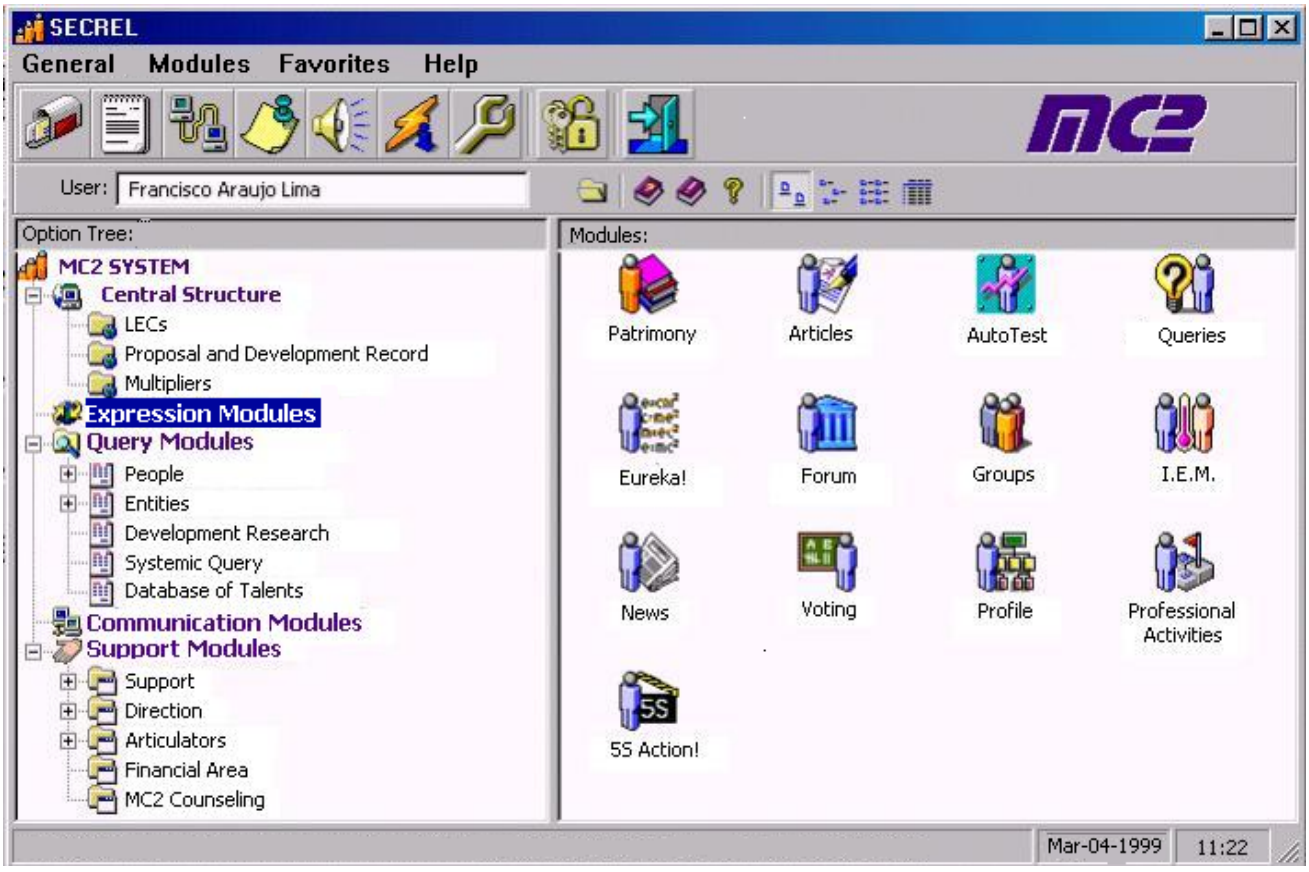
The support modules allow the customization of the MC^2 system to the reality of different institutions and also serve to support the perfect implementation and utilization of the MC^2 strategy. They contain procedures: 1) of the logical maintenance of the system; 2) of safety to protect knowledge property of the organization; 3) of the system's adaptation to the reality of each enterprise; and 4) of support to the functions to promote development

	Direction – Functions of general configuration, standardization and concession of qualifications
	Articulators – Space for maintenance of functions carried out by the articulator to promote the development of the organization
	Financial Area – Space where it is possible to define the limits of financial autonomy
	MC^2 Counseling – Functions to implement, expand and deepen MC^2 Strategy in the organization

Knowledge Engineering in MC^2

At the knowledge level of MC^2, we have defined a set of tools based on Artificial Intelligence to deal with both information and data stored. These tools are modeled in intelligent agents that are divided into 5 groups: Agents who do searches, Agents who analyze profiles, Agents who discover knowledge, Agents inducers of discussions, and Agents who do diagnosis. To carry out these activities, these agents make use of knowledge bases

Figure 2. Snapshot of MC^2 and its expression modules



represented in production rules and frames about the concepts of their work context. The frame hierarchies are mainly used to model the concepts represented in the List of Essential Competencies (LEC) of the central structure (described in 4.1).

Search agents make use of ontologies to retrieve a person with the proper profile to carry out a certain task as well as to carry out searches of information and news required by users. These agents basically act on the query modules (described in 4.4). Profile analysis agents help in the task to characterize. These agents also analyze the possibility of promoting a candidate to be a multiplier of a certain user in function of his/her performance in the organization. Basically, these agents act integrated to the support modules (described in 4.5) and to multipliers' module (described in 4.1). These agents strongly resort to information fed by the expression modules such as patrimony, articles, ideas, questions and answers of experts, etc. (see 4.2)

Agents who discover knowledge use non-supervised learning algorithms (Vasco Furtado 1996) to explore the MC^2 database, searching for correlation between users' characteristics. This activity permits the creation of groups of interest formed by the MC^2 users.

Agents who do diagnosis check the consistency of information entered into the system by identifying failures in operations and suggesting actions to the multipliers. These agents are important for the perfect achievement of the support and workshop modules (see 4.5 and 4.3).

Agents that are inducers of discussion try to make use of the database of the end activities of the organization and of the MC^2 database where the solutions to everyday problems are recorded (eureka! modules, articles and consultation of 4.2). These data are filtered and distributed in the organization to generate discussion and assimilation by all, of the way the problems of the organization are being solved.

Conclusion

We have described a strategy to improve learning organization through the use of information systems and knowledge engineering. The basic idea of MC^2 is to give condition to people's participation in the organization via a software environment, which facilitates interaction between the organization components and favors formalization and further exploration of knowledge. The software MC^2 is being implemented in Microsoft Visualbasic under windows/NT platform. MC^2 has been used in the context of a software-house and Internet provider with more than hundred employees. We intend to implement it in larger distributed enterprise so that we can improve the knowledge level agents in MC^2, developing web-based agents in order to use them in Internet.

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